CLAIMS

What is claimed is:

1. A method of generating parity data based on a parity check matrix H having p codewords of length c, each codeword being divided into a message word of length m and parity data of length p, the method comprising:

reordering a plurality of columns of the parity check matrix H based on elements in each of the columns having values of one to generate a reordered parity check matrix H';

determining a cross-point I between a diagonal line L2 of a parity matrix part Mp in the parity check matrix H' and a reordered diagonal line L1 defined by a first entry of an element having a value of one in each column of the reordered parity check matrix H';

performing column permutations on the reordered parity check matrix H' on the basis of positions of elements having a value of one in rows above a horizontal line L3 that passes through the cross-point I to generate a triangular matrix T;

calculating values using the triangular matrix T and the message words to obtain a first part of the parity data; and

satisfying the equation Hx=0, where x is a codeword matrix, to obtain a remaining second part of the parity data.

2. The method of claim 1, wherein the reordering a plurality of columns of the parity check matrix H comprises:

finding a first entry of an element having a value of one in each column in the parity check matrix H; and

reordering the columns from left to right in the order of highest entry of an element having a value of one 1 in each column.

3. The method of claim 1, wherein the determining a cross-point I comprises sequentially exchanging, with respect to a horizontal line L3, from left to right columns of a message matrix part Mm with columns of the parity matrix part Mp in the reordered parity check matrix H'.

4. The method of claim 1, wherein the calculating values using the triangular matrix T is performed by a backward-substitution method.

5. The method of claim 1, wherein the satisfying the equation Hx=0 is performed by a Gaussian elimination method.

6. A method of generating parity information based on a parity check matrix H having p codewords of length c, each codeword being divided into a message word of length m and parity data of length p, the method comprising:

reordering columns in the parity check matrix H based on elements in each column having values of one to obtain a reordered parity check matrix H';

determining a cross-point I between a diagonal line L2 of a parity matrix part Mp that corresponds to a parity information part in the parity check matrix H' and a reordered diagonal line L1 defined by a first entry of an element having a value of one in each column of the reordered parity check matrix H';

performing column permutations on the reordered parity check matrix H' on the basis of positions of elements having a value of one in rows above a horizontal line L3 that passes through the cross-point I to form a triangular matrix T; and

performing row and column permutation for rows under the horizontal line L3 based on the positions of elements having a value of one in the rows under the horizontal line L3 to form an extended triangular matrix T; and

calculating values using the extended triangular matrix T and the message words to obtain the parity data.

7. The method of claim 6, wherein the performing row and column permutations comprises:

checking whether there is a row under the horizontal line L3 having a second element from right to left having a value of one to the left of the diagonal line L2 of the parity matrix part Mp in the reordered parity check matrix H';

exchanging the row under the horizontal line L3 having a second element from right to left having a value of one to the left of the diagonal line L2 with a top-most row under the horizontal line L3; and

exchanging a first column having an element having a value of one in the newly exchanged top-most row on the right of the diagonal line L2 with a second column having an element having a value of one in the newly exchanged top-most row on the nearest left of the diagonal line L2.

8. The method of claim 7, wherein the operations are repeatedly performed until a row no longer exists having a second element from right to left having a value of one to the left of the diagonal line L2.

9. The method of claim 6, wherein the calculating values using the extended triangular matrix T comprises generating a part of the parity data using the extended triangular matrix and the message words.

10. The method of claim 9, wherein the generating a part of the parity data is performed by backward-substitution calculation.

11. The method of claim 6, wherein the calculating values using the extended triangular matrix T comprises generating remaining parts of parity data by Gaussian elimination.

12. An apparatus for generating parity information based on a parity check matrix H having p codewords of length c, each codeword being divided in a message word of length m and parity data of length p, the apparatus comprising:

a parity check matrix generator reordering columns in the parity check matrix H, based on elements in each column having elements with a value of one to generate a reordered parity check matrix H';

a triangular matrix generator for determining a cross-point I between a diagonal line L2 of a parity matrix part Mp in the parity check matrix H' and a reordered diagonal line L1 defined by a first entry of an element having a value of one in each column of the reordered parity check matrix H', and, on the basis of positions of elements having a value of one in rows above a horizontal line L3 that passes through the cross-point I to perform column permutations on the reordered parity check matrix H', to generate a triangular matrix T;

a calculator calculating values using the triangular matrix T and the message words to obtain a first part of the parity data;

a calculator calculating values satisfying the equation Hx=0, where x is a codeword matrix, to obtain a remaining second part of the parity data.

13. The apparatus of claim 12, wherein the parity check matrix generator comprises:

a calculator to find a top position of each element having a value of one for each column in the parity check matrix H; and

a column permutator to reorder columns from left to right in the order of the highest entry of an element having a value of one for each column.

14. The apparatus of claim 12, wherein the triangular matrix generator sequentially exchanges from left to right columns of a message matrix part Mm with columns of the parity matrix part Mp in the reordered parity check matrix H', with for elements above the horizontal line L3.

15. The apparatus of claim 12, wherein the calculator calculating values using the triangular matrix T and the message words generates parity data by a backward-substitution calculation.

16. The apparatus of claim 15, wherein the triangular matrix generator generates the parity data by a Gaussian elimination.

17. An apparatus for generating parity information based on a parity check matrix H having p codewords of length c, each codeword being divided into a message word of length m and parity data of length p, the apparatus comprising:

a parity check matrix generator reordering columns in the parity check matrix H, based on elements in each column having values of one to generate a reordered parity check matrix H';

a triangular matrix generator determining a cross-point I between a diagonal line L2 of a parity matrix part Mp in the parity check matrix H and a reordered diagonal line L1 defined by a first entry of an element having a value of one in each column of the reordered parity check matrix H', and, on the basis of positions of elements having a value of one in rows above a horizontal line L3 that passes through the cross-point I to perform column permutations on the reordered parity check matrix H', to generate a triangular matrix T; and

a column permutator to permutate rows and columns based on the positions of elements having a value of one in the rows to form an extended triangular matrix T, for rows under the horizontal line L3; and

a calculator calculating values using the extended triangular matrix T and the message words to generate the parity data.

18. The apparatus of claim 17, wherein the column permutator comprises:

a checker checking whether there is a row under the horizontal line L3, in which a second element from right to left having a value of one is to the left of the diagonal line L2 of the parity matrix part Mp in the reordered parity check matrix H';

a first exchanger exchanging the row under the horizontal line L3, in which a second element from right to left having a value of one is to the left of the diagonal line L2 with a top-most row under the horizontal line L3,; and

a second exchanger exchanging a first column having an element having a value of one in the newly exchanged top-most row on the right of the diagonal line L2 with a second column having an element having a value of one in the same top-most row on the nearest left of the diagonal line L2.

19. The apparatus of claim 17, wherein the calculator calculating values using the extended triangular matrix T generates part of the parity data by a backward substitution calculation using the extended triangular matrix and the message words.

20. The apparatus of claim 17, wherein the calculator calculating values using the extended triangular matrix T generates the remaining parity data by Gaussian elimination.

21. A method of generating parity data, the method comprising:

reordering a plurality of columns of a parity check matrix based on values of elements in the columns to generate a reordered parity check matrix;

determining a cross-point between a diagonal line through the parity matrix portion of the parity check matrix and a reordered diagonal line defined by values of elements in each column of the reordered parity check matrix;

performing column permutations on the reordered parity check matrix according to positions of elements relative to a horizontal line that passes through the cross-point to generate a triangular matrix; and

calculating values using the triangular matrix and message words to obtain the parity data.

22. The method according to claim 21, wherein the reordering a plurality of columns comprises:

finding an entry of an element having a first value in each column in the parity check matrix; and

reordering the columns on the basis of a position of elements having the first value in each column.

23. The method according to claim 21, the determining a cross-point comprises sequentially exchanging with respect to a horizontal line through the matrix from columns of a message matrix part with columns of the parity matrix part in the reordered parity check matrix.

24. The method according to claim 21, wherein the calculating values using the triangular matrix is performed by a backward-substitution method.

25. The method according to claim 21, wherein part of the parity data is found by a Gaussian elimination.

26. A method of generating parity information, comprising:

reordering columns in a parity check matrix based on values of elements in each column to obtain a reordered parity check matrix;

determining a cross-point between a diagonal line of a parity matrix part that corresponds to a parity information part in the parity check matrix and a reordered diagonal line defined by a position of an element having a first value in each column of the reordered parity check matrix;

performing column permutations on the reordered parity check matrix on the basis of positions of elements having a second value relative to a horizontal line that passes through the cross-point to form a triangular matrix; and

performing row and column permutation to form an extended triangular matrix; and

calculating values using the extended triangular matrix and message words to obtain the parity data.

27. The method of claim 26, wherein the performing row and column permutations comprises:

checking whether there is a row relative to the horizontal line having an element with a first value in a first position relative to the diagonal line of the parity matrix portion in the reordered parity check matrix;

exchanging the checked row with a top-most row under the horizontal line; and

exchanging a first column having an element having the first value in the exchanged top-most row with a second column on the opposite side of the diagonal line having the first value in the exchanged top-most row.

28. The method according to claim 26, wherein the calculating values using the extended triangular matrix comprises generating a part of the parity data using the extended triangular matrix and the message words.

29. The method of claim 26, wherein the generating a part of the parity data is performed by backward-substitution calculation.

30. The method according to claim 26 wherein part of the data is generated by Gaussian elimination.